

# The *Conchoecia reticulata* species-group, with descriptions of *C. reticulata* Müller (1906), *C. caudata* (1891), and two new species

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## Introduction

G. W. Müller (1906) described *Conchoecia reticulata* from Tiefsee-Expedition material. He states that the shell has a striking sculpture mainly of squares or rectangles which are organised into near-horizontal rows in the dorsal half and descending rows in the ventral half, and that some animals have spines like those of *C. caudata*. This description seems to indicate that there were two forms of *C. reticulata*, a spined and an unspined form.

Since this description several authors have reported *C. reticulata*, Granata & di Caporiacco (1949), Deevey (1968, 1980), Poulsen (1969, 1973), Angel & Fasham (1975) and Angel (1979). The material identified by Granata & di Caporiacco (1949) was undoubtedly the spined form as they used the distinctive carapace spines as one of the characters for their new genus *Macroconchoecia* in which they placed *caudata* and *reticulata*. Deevey (1968) did not mention the spines nor draw them, but in 1980 she confirmed that her specimens, including the specimens described in 1968, bore the distinctive *C. caudata* pattern of spines. Similarly Poulsen (1969) did not make clear whether the six adults caught in the Gulf of Guinea bore spines but later in his 1973 Dana Report he writes that the species is 'easy to recognise by the strong, partly spinous reticulation of the shell' thus implying that all his specimens, including those described in 1969, were spined.

In a recent paper Angel (1979) was the first author since Müller to record two forms of *C. reticulata*. In *Discovery* material from 30°N 23°W he found a smaller deep mesopelagic form characterised by rows of short spines, a larger deeper-living form without spines, and suggested that *C. reticulata* was probably a mixture of two species.

Further examination of *Discovery* material comprising 242 adult specimens led to the conclusion that there were not two forms of *C. reticulata* but three. Besides the spined form and the larger unspined form noted by Angel (1979) there was a smaller unspined form. In the absence of a type specimen or syntypes, I was unable to obtain Müller's Tiefsee-Expedition material, the name *C. reticulata* has been given to the smaller of the two unspined forms. The spined form was excluded on the grounds that it is not the species Müller figured and the terms of his description, whilst clearly including this species, implies that he regarded it as the more atypical form. The larger unspined form was also excluded as the size Müller gave for the male, 3.1 mm is outside the range of 3.4–4.0 mm for the male of this species. Furthermore the depth ranges of the adult spined form and the smaller unspined form are similar, whilst the larger unspined form lives deeper. In *Discovery* samples, with the exception of haul 38 at station 6665 which fished a wide horizon from 1800–3600 m, the adults of the large unspined form and the spined form were not taken in the same haul. Hence it would seem more likely that Müller's unspined form would have been the small species. The large unspined form and the spined form are therefore described below with the names *C. macroreticulata* and *C. spinireticulata* respectively, re-descriptions of *C. reticulata* and *C. caudata* are also provided. Four tables giving precise station data for all material of *C. reticulata*, *C. macroreticulata*, *C. spinireticulata* and *C. caudata* identified from *Discovery* collections are stored in the libraries of the BM(NH) and Institute of Oceanographic Sciences.

*Conchoecia reticulata* Müller 1906

*Conchoecia reticulata* G. W. Müller 1906 (*pro parte*) *Ergeb. Tiefsee-Exp.* 8 p. 64, pl. 12 f 10–17.

*Conchoecia reticulata* G. W. Müller 1912 (*pro parte*) *Das Tierreich—Ostracoda* Berlin p. 71.

**Male**

A male of carapace length 3.1 mm mounted on slides in Euparal and stained with lignin pink has been deposited at the BM(NH) No. 1982: 184. It was caught at *Discovery* station 6665 (10°16.4'N, 19°47.4'W) haul 32 with the N113 (Foxton, 1969).

*Carapace* (Figs 1A–D). The length of the seven males ranged between 2.8 mm and 3.1 mm averaging 2.99 mm. Only one of the males was sufficiently intact to measure breadth and height of the carapace accurately, both were about 40% of the length. The posterior dorsal corner is nearly a right angle with the left valve corner rounded off and the right produced into a short spine often with a short secondary spine. The left asymmetrical gland opens anterior to the hinge on a small protuberance. Just ventral to the corner, on both valves, are a pair of glands whose function is unknown. The posterior margin is rounded and slanted slightly forwards, along it are scattered edge glands. The posterior ventral corner is strongly rounded and the right asymmetrical gland opens dorsally to it. The ventral edge is nearly parallel to the dorsal edge. In the anterior third it is slightly reflexed outwards and is armoured with small spines derived from extensions of the sculpture. These spines occur on both valves but are larger and more prominent on the left valve. In ventral view the carapace is narrow and smoothly rounded. The rostrum is pointed and short, the length being about one-third the width across the rostral incisure.

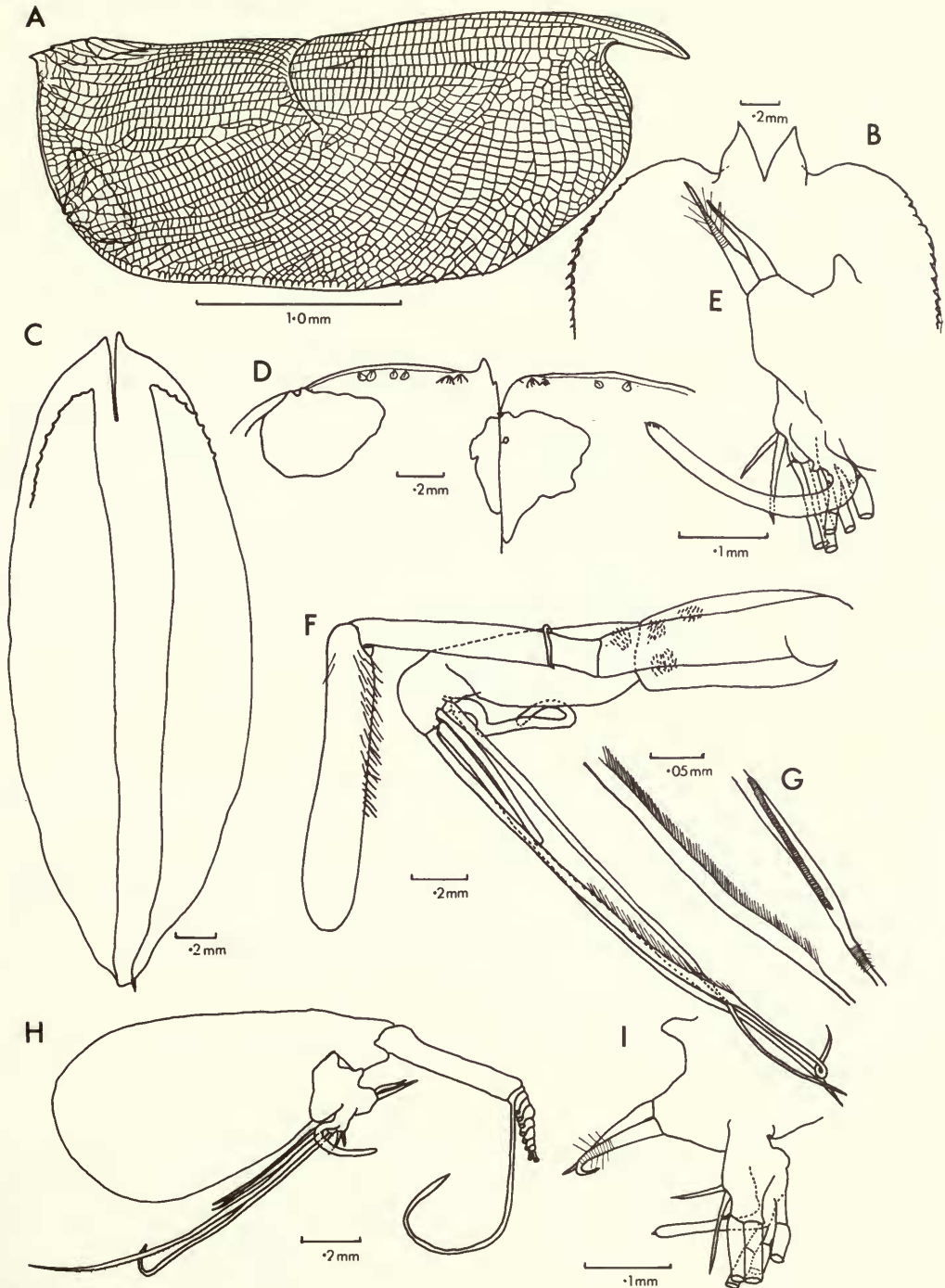
The sculpture is distinct, in the dorsal half the markings are largely rectangles which are organised into horizontal rows running parallel to the dorsal hinge. In the ventral half they are more squarrous and run diagonally slanting postero-ventrally. Near the ventral margin the markings become more polygonal, at the centre of each valve and along the posterior margin the markings are weaker and more irregular.

*Frontal organ* (Fig. 1F). The shaft reaches level with the end of the second segment of the first antenna and the capitulum is downturned, slightly expanded distally. The tip is rounded. Proximally there are long fine bristles on the capitulum, these are concentrated mainly on the ventral side and extend half way along its length.

*First antenna* (Figs 1F & G). The first two segments are subequal and have some discrete patches of short bristles. The *a* seta is shorter than the second segment and has a kink proximally. The *c* seta is a similar length but straight. The *b*, *d* and *e* setae are all about three times the length of the *a* and *c* setae. The *e* seta carries two rows, each of approximately 50 fine spines which are strongly basally directed. Deevey & Brooks (1980) described them as a 'very thick double row of countless slim lamellae'. The *b* seta has a long, thin, crenulated and horizontally-banded, wing-like callus and a pad with close-set annuli edged with short lateral bristles opposite the distal end of the *e* seta armature. The *d* seta has a few tiny spinules in an equivalent region.

*Second antenna* (Figs 1E, H & I). The protopodite is nearly 45% of the carapace length, longer than the longest swimming seta which is only 36%. On the endopodite, the *g* seta is three-quarters the length of the *f* seta which is about 43% of the carapace length. The *h*, *i* and *j* setae are much shorter, about 19% of the carapace length. With the exceptions of the *f* seta, which has a few short bristles distally and the *b* seta which has a few fairly long bristles, the setae are bare. The *c*, *d* and *e* setae are present.

The hook appendage on the right endopodite has a short straight basal part, with a well-marked process on the anterior side, followed by a sharp bend and a long, curving arm. The tip of the hook is faintly ridged dorsally and armed with a short projection. The left hook appendage is smaller. It lacks a process on the short stalk and has a marked right-angled bend. The main part of the arm is straight. The tip is not obviously ridged but armed with a short projection.



**Fig. 1** *C. reticulata* ♂. A: Carapace, lateral view. B: Anterior carapace flattened to show the ventral edge spines. C: Ventral view of carapace. D: Detail of the posterior carapace glands. E: Detail of the endopodite of the right second antenna. F: Frontal organ and first antenna. G: Detail of *b* and *e* setae armatures. H: Second antenna. I: Detail of endopodite of the left second antenna.

*Mandible* (Figs 2B & E). The basale carries a small seta near the insertion of the endopodite with two long and two shorter setae on the inner face near the toothed edge, the *pars incisa*. The pattern of toothing is typical of the genus, there are several clusters of hairs and a row of hairs below the two spine teeth.

The first segment of the endopodite bears on the outer edge a single seta, with a row of long fine bristles on one side, and on the inner edge four setae, three of which are plumose proximally. The second segment has a fringe of long hairs on the outer edge and bears five setae. The third segment has a large patch of hairs on its inner surface and bears seven setae. The longest terminal claw seta is as long as the total length of the endopodite.

The toothed edge of the coxale has nine teeth. The middle ridge has two tusk-like posterior teeth the inner of which has an irregularly serrate margin followed by 13–14 small teeth. The proximal ridge has 12 irregularly sized teeth, the first, third and fifth posterior teeth being larger than either the teeth between or the anterior teeth.

*Maxillula* (Figs 2C & H). There is a basal seta. The first endopodite segment has six anterior, one lateral and three posterior setae.

*Fifth limb* (Fig. 2A). The first segment of the exopodite has several groups of setae. There is a group of four setae near its base, of which two are short and of the two longer setae one is plumose. Above these are two setae inserted laterally, distally there are four more ventral setae and a further two setae more dorsally, one of which is plumose and on a protuberance. The second segment bears two setae ventrally and one dorsally. On the terminal segment the central claw seta is large, robust and bears short bristles distally. The dorsal seta is slightly thicker and longer than the ventral one, both are bare.

*Sixth limb* (Fig. 2J). The basal segment carries six plumose setae and one bare seta. The second segment has one, bare ventral seta. The third segment has two setae one dorsally and one ventrally placed. The ventral of the terminal bristles is bare.

*Caudal furca* (Fig. 2G). Each furcal plate carries the eight claw setae normal for adults of the genus and there is a single unpaired seta dorsally.

*Penis* (Fig. 2F). This is long parallel-sided and blunt-ended with five oblique muscle bands.

## Female

A female of carapace length 3.4 mm, stained with lignin pink and mounted on slides in Euparal, has been deposited at the BM(NH) No. 1982: 183. It was caught at *Discovery* station 6665 (10°17.3'N 19°49.0'W) haul 28 with the N113.

*Carapace* (Figs 3A, C & E). The twelve female specimens and five detached carapaces of females, had a carapace length range of 3.2 mm to 3.4 mm averaging 3.30 mm, a little larger than the males. Overall the shape of the female carapace is similar to the male, but the rostrum is relatively longer, the length is about two-thirds of the width across the rostral incisure. The nature and position of the carapace glands, the pattern of sculpture and the ventral edge spines are the same as the male.

*Frontal organ* (Fig. 3D). The shaft extends beyond the end of the second segment of the first antenna. The shape of the capitulum is the same as the male. The proximal bristles are short, fine and numerous.

*First antenna* (Fig. 3D). The limb is well-differentiated into segments, both with discrete patches of short bristles. The dorsal seta is relatively long. The *a–d* setae are about 1/3 of the length of the *e* seta, which is about 1/3 of the carapace length. On the anterior surface of the *e* seta there is, proximally, a row of long fine hairs and distal to these, a row of short bristles which lie nearly flat against the surface of the principal seta. On the posterior surface, opposite the anterior short bristles, there are some slightly longer bristles which are fairly closely spaced proximally, but become more widely spaced distally where the principal seta is broadened and flattened.

*Second antenna* (Figs 3B & G). The protopodite is about 41% of the carapace length, nearly 2½ times the length of the first exopodite segment. The longest swimming seta is 3/4 the length of the protopodite. On the endopodite the *a* and *b* setae are bare, *c*, *d* and *e* setae are absent,

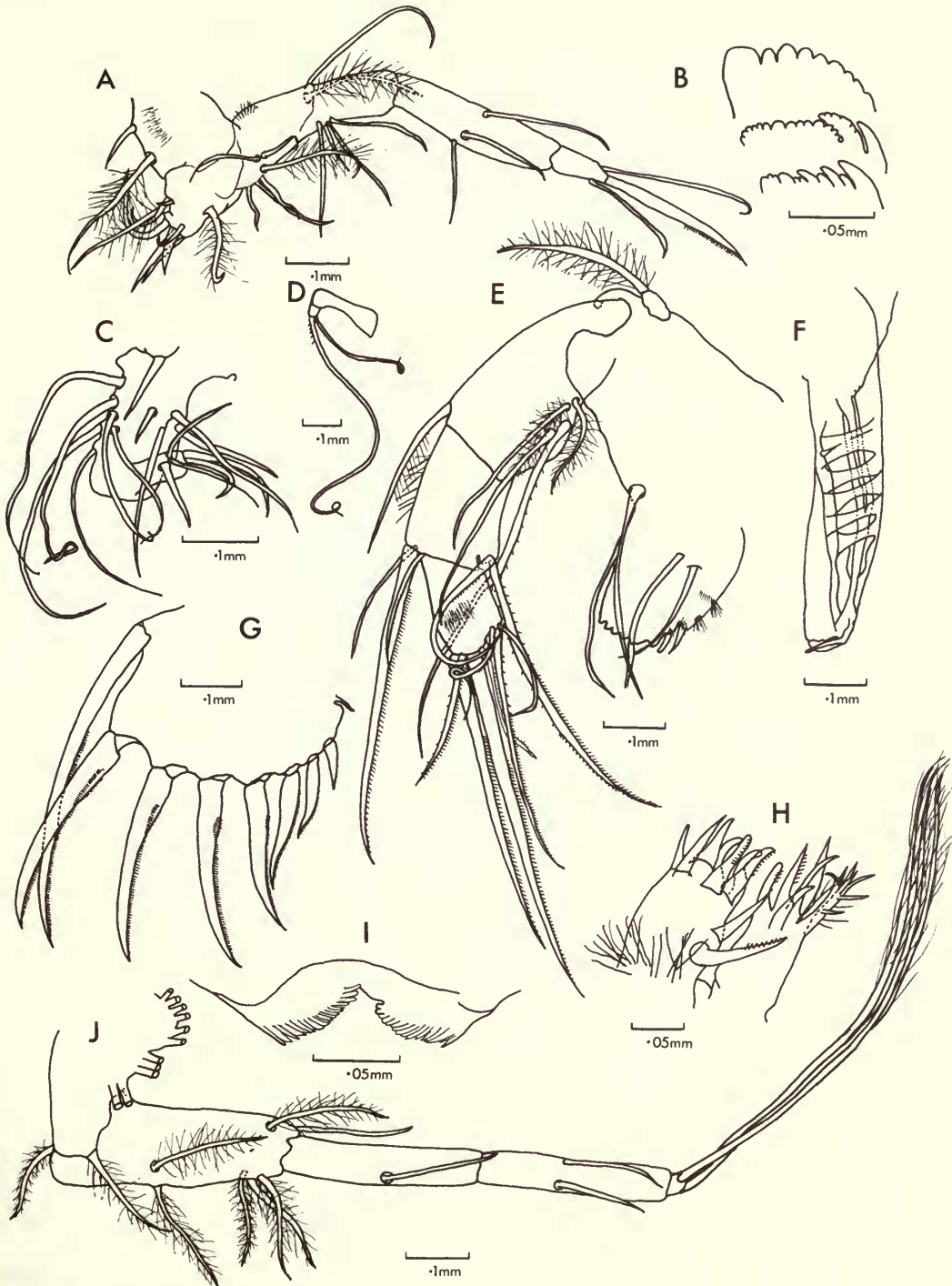
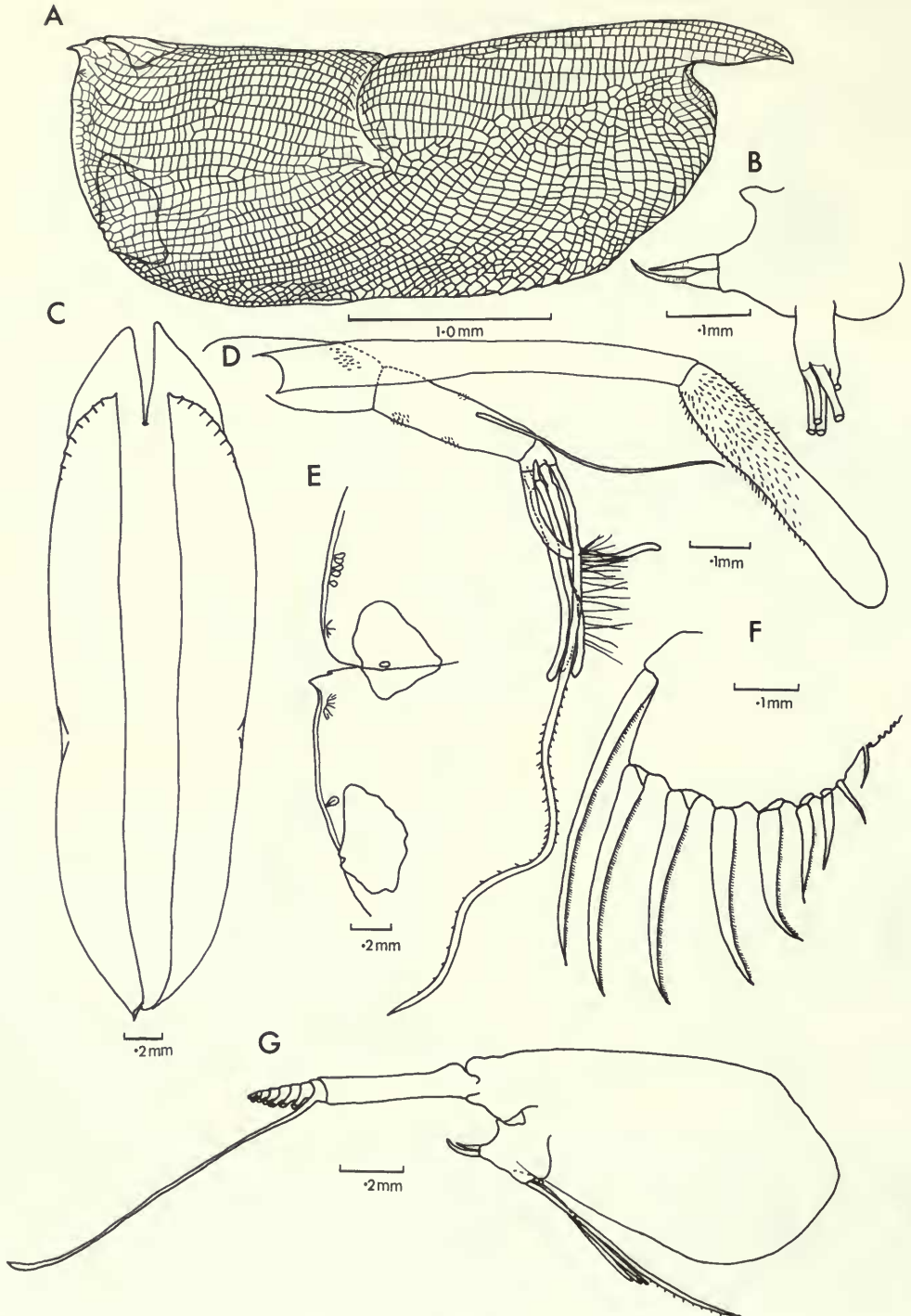


Fig. 2 *C. reticulata* ♂. A: Fifth limb. B: Toothed edge of the coxale and tooth lists. C: Maxillula endopodite. D: Seventh limb. E: Basale, and endopodite of the mandible. F: Penis. H: Coxa of maxillula. I: Toothed edge of labrum. J: Sixth limb.



**Fig. 3** *C. reticulata* ♀. A: Carapace, lateral view. B: Detail of the endopodite of the second antenna. C: Ventral view of carapace. D: Frontal organ and first antenna. E: Detail of posterior carapace glands. F: Caudal furca. G: Second antenna.

the *f* seta was damaged in all twelve females, the *g* seta is about 24% of the carapace length and carries a few widely-spaced bristles.

*Other appendages* (Figs 3F & 4A–G). These are all similar to those of the male with the exceptions of the single, outer-face seta of the first segment of the mandibular endopodite which has a row of short bristles rather than the long ones seen in the male, and the usual differences in the sixth limb which are typical of the genus.

REMARKS. 32 specimens were identified from *Discovery* material; all from the comparatively rarely sampled deep meso- or bathy-pelagic levels, at stations between 0° and 20°N in the Atlantic. Besides the seven males and seventeen females there were two stage VI juveniles (2.3 and 2.5 mm) and six stage V juveniles (1.7, 1.8, 1.8, 1.8, 1.8 and 1.9 mm). They were distinguished from *C. macroreticulata* juveniles by the presence of ventral edge spines as well as size and shape. Juveniles seem to occur between 1000–1500 m deep and adults between 1500 m and 2500 m. These depth ranges and the geographic range cannot be regarded as definitive.

### *Conchoecia macroreticulata* sp. nov.

*Conchoecia reticulata* Müller 1906. M. V. Angel, 1980, *Prog. Oceanog.* 8, p. 57–58.

*Conchoecia reticulata* Müller 1906. M. V. Angel, 1981 in *Atlas del Zooplankton del Atlantico sudoccidental* ed. D. Boltovskoy, p. 559 f. 194–77.

### Male

The holotype, stained with lignin pink and mounted on slides in Euparal, has been deposited in the BM(NH) No. 1982: 187. It has a carapace length of 3.9 mm and was caught at *Discovery* station 9541 (20°11.4' N 21°40.9' W) haul 26 with the RMT 1 (Baker *et al.*, 1973).

*Carapace* (Figs 5A, C & H). The length range of the ten males and eleven detached carapaces of males was 3.4 mm to 4.0 mm averaging 3.73 mm. Both breadth and height of the carapace were about 40% of the carapace length. The shape of carapace is fairly similar to that of *C. reticulata* but the ventral edge lacks any projecting spines and the height of the carapace narrows anteriorly. The asymmetrical glands, paired glands and the edge glands are similar in their positions to those of *C. reticulata*. In ventral view the carapace is smoothly rounded, the rostrum is short and pointed. The organisation of the sculpture is similar to that of *C. reticulata* but slightly more pronounced, and the parallel rows in the posterior dorsal quarter rise towards the dorsal hinge.

*Frontal organ* (Fig. 5E). The details of shape, hirsuteness and relative size of the frontal organ are like those of *C. reticulata*.

*First antenna* (Fig. 5E). This appendage is similar to that of *C. reticulata* but the proportions of the setae differ. The *c* seta is about three-quarters the length of the *a* seta (Table 1). The *b* and *d* setae are 42%, and the *e* seta 49% of the carapace length, about four times the length of the *c* seta, relatively longer than these setae in *C. reticulata* which are only three times the *c* seta length. The armature of the setae is similar and the *e* seta bears about 50 pairs of spines.

*Second antenna* (Figs 5B, D & G). The main differences from *C. reticulata* are that the longest swimming seta is relatively longer, as are the *f* and *g* setae.

*Sixth limb* (Fig. 6H). Some of the plumose setae of the basal segment have rather sparse hairs otherwise this limb is like that of *C. reticulata*.

*Penis* (Fig. 6E). There are six oblique muscle bands compared to five in *C. reticulata*.

*Other appendages*. These are all similar to those of *C. reticulata*.

### Female

The paratype specimen, carapace length 4.3 mm, stained with lignin pink and mounted on slides in Euparal has been deposited at the BM(NH) No. 1982: 188. It was caught at *Discovery* station 9541 (20°11.4' N 21°40.9' W) haul 26 with the RMT 1.

**Table 1** Some morphometric characters of the *reticulata* group of species. Proportions of carapace, frontal organs and first and second antennae expressed as percentages of the total carapace length

	<i>C. reticulata</i>			<i>C. spinireticulata</i>			<i>C. macroreticulata</i>			<i>C. caudata*</i>		
	♂	SD	♀	♂	SD	♀	♂	SD	♀	♂	SD	♀
Range (mm)	2.8-3.1		3.2-3.4	2.8-3.4		3.2-3.9	3.4-4.0		3.8-4.4	4.8-6.1		6.7-7.6
Mean length	3.0	0.1	7	3.2	0.2	88	3.4	0.1	10	5.6	0.5	5
Height	40.5	—	1	39.1	3.2	19	40.4	2.4	3	40.9	2.1	3
Breadth	39.2	—	1	37.9	1.7	12	39.2	0.6	2	43.8	3.4	3
FO capit	17.3	0.6	6	16.2	0.8	20	17.2	1.1	9	22.9	1.2	5
shaft	26.9	1.1	6	21.9	1.0	12	29.5	1.3	20	21.1	0.8	18
Ant 1 segt 1	14.6	1.1	6	8.9	1.2	12	17.7	1.2	20	9.2	0.7	18
" 2	14.7	1.1	6	8.7	0.5	12	16.0	1.1	20	8.9	2.9	18
a seta	11.7	0.9	5	10.7	0.5	12	11.3	1.6	18	10.8	1.0	18
b "	33.6	0.7	5	—	—	—	41.3	2.7	8	—	—	—
c "	10.8	0.4	6	—	—	—	8.2	0.9	20	—	—	—
d "	33.8	1.7	5	—	—	—	42.1	1.2	20	—	—	—
e "	36.3	2.9	—	31.4	1.8	7	48.1	1.3	19	48.7	3.9	7
Spines	50×2			83×2			50×2			95×2	(+4)	
Ant 2 Protop	44.4	1.4	—	40.9	1.3	12	45.0	1.6	20	45.6	2.0	5
Exop 1	18.1	1.4	6	17.4	0.9	12	18.1	0.7	20	18.9	0.6	7
" 2-8	8.5	1.1	6	6.9	0.3	12	7.8	0.3	20	7.2	0.3	7
LSS	36.5	4.7	2	34.7	2.8	5	41.4	2.9	19	44.0	1.4	5
f seta	42.6	2.1	4	—	—	—	51.1	1.8	16	40.2	1.7	11
g seta	33.3	1.8	3	24.2	1.5	4	37.0	1.9	18	25.3	1.0	18
h i j seta	18.9	1.1	5	18.1	1.1	7	16.1	0.9	20	16.7	1.0	19
										17.8	0.8	8
										39.6	1.1	19
										49.4	2.9	5
										19.2	0.8	5
										8.1	0.4	5
										47.0	2.0	5
										60.5	6.7	3
										40.6	2.4	5
										37.3	1.9	7
										17.6	1.0	5
										45.6	1.8	8
										18.2	0.7	8
										8.0	0.6	8
										41.5	2.0	7
										52.7	2.0	4
										37.3	1.9	7
										21.1	1.6	7

\*% values based on carapace length measured from the base of the posterior dorsal spine to the rostral incisure as rostrum and spine are easily damaged.



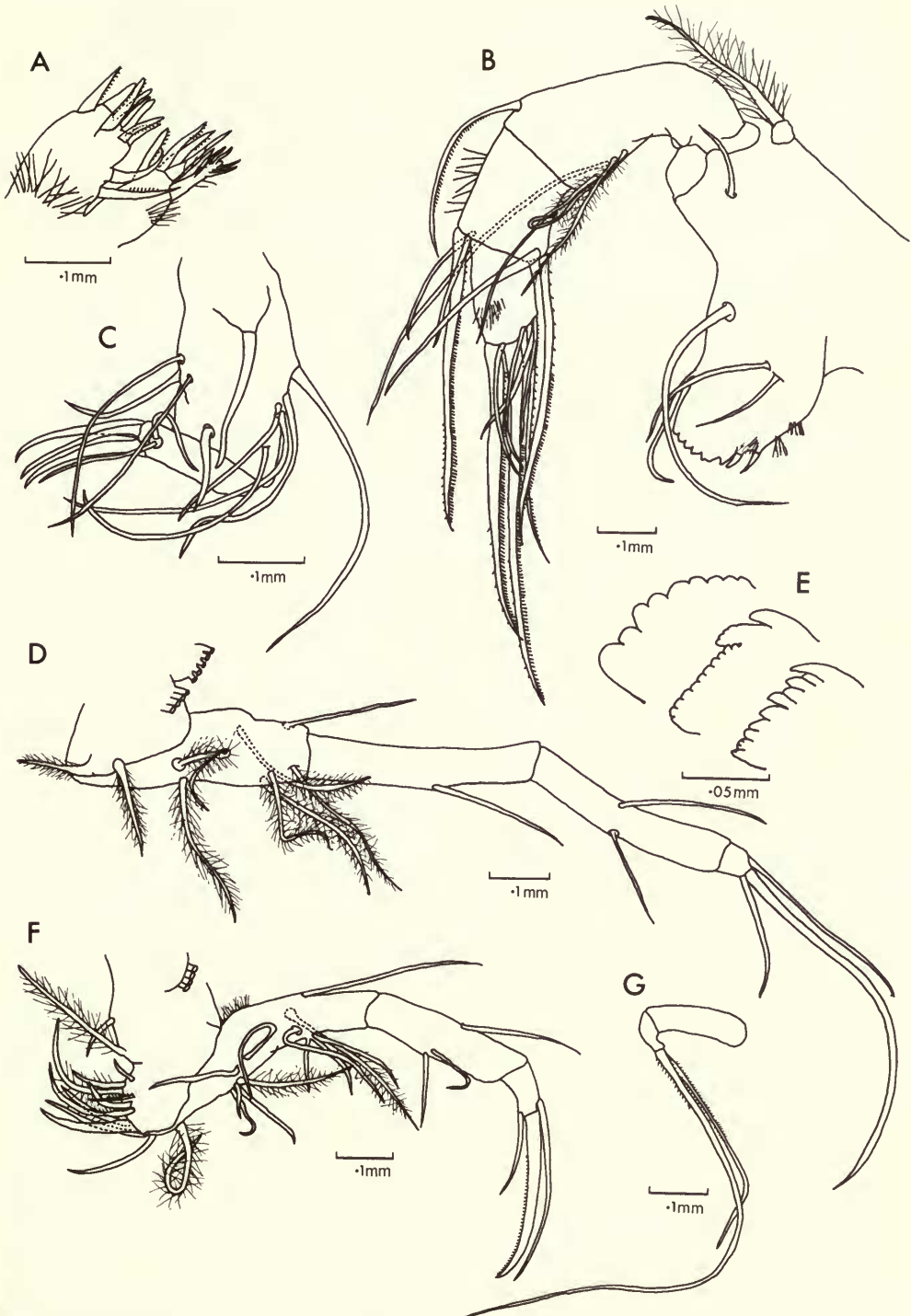


Fig. 4 *C. reticulata* ♀. A: Coxa of maxillula. B: Basale and endopodite of mandible. C: endopodite of maxillula. D: Sixth limb. E: Toothed edge of coxale and tooth lists of mandible. F: Fifth limb. G: Seventh limb.

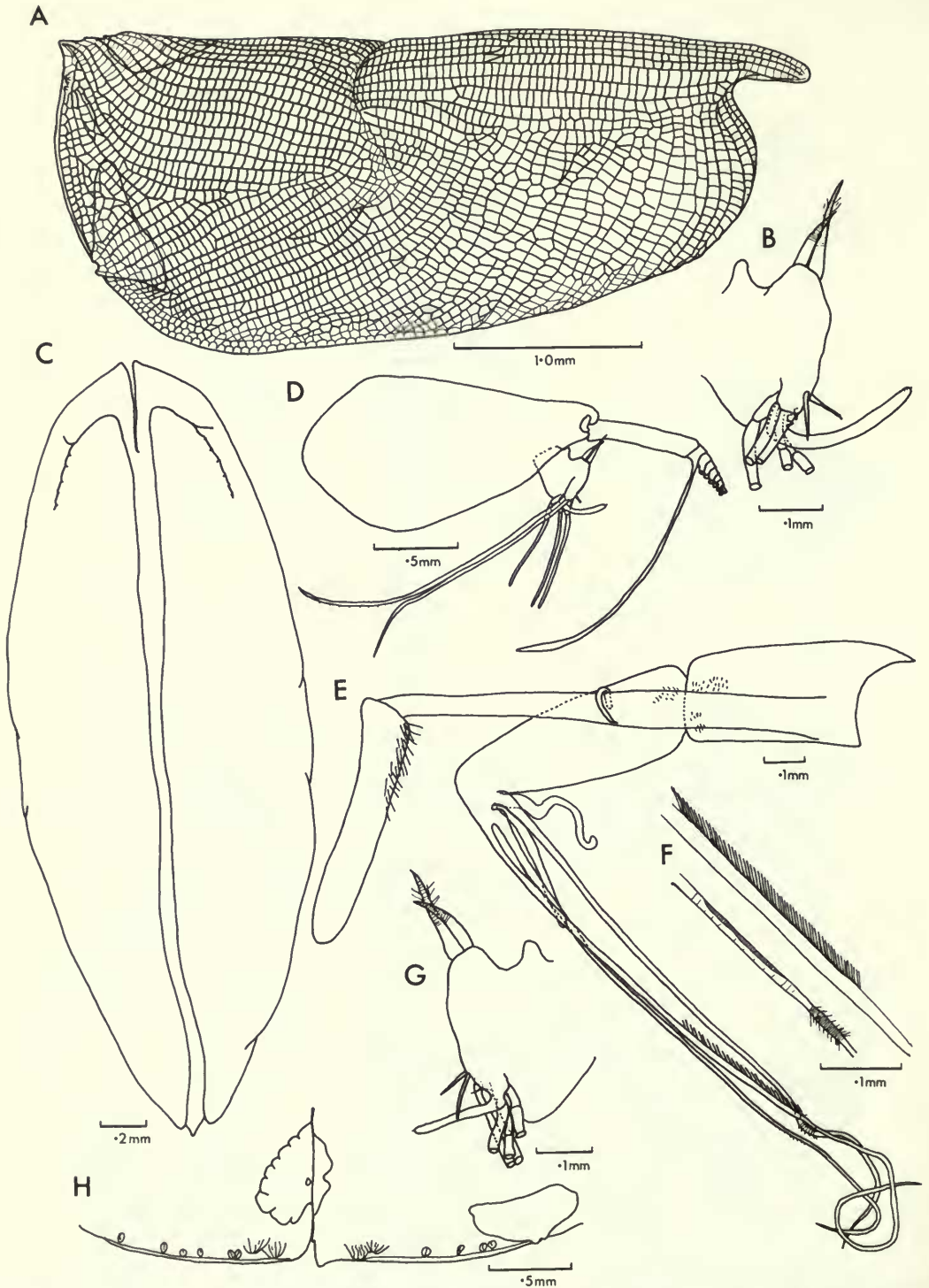


Fig. 5 *C. macroreticulata* ♂. A: Carapace, lateral view. B: Detail of the endopodite of the right second antenna. C: Ventral view of carapace. D: Second antenna. E: Frontal organ and first antenna. F: Detail of the *b* and *e* seta armatures. G: Detail of the endopodite of the second antenna. H: Detail of the posterior carapace glands.



Fig. 6 *C. macroreticulata* ♂. A: Coxa of maxillula. B: Basale and endopodite of mandible. C: Endopodite of maxillula. D: Toothed edge of coxale and tooth lists of mandible. E: Penis. F: Caudal furca. G: Toothed edge of labrum. H: Sixth limb. I: Seventh limb. J: Fifth limb.

*Carapace* (Figs 7A, C & F). The 28 female specimens and six detached carapaces of females showed a carapace length range of 3.8 mm to 4.4 mm averaging 4.14 mm. The shape and sculpturing of the carapace is like that of the male but the rostrum is much longer and tapered. The asymmetrical glands, paired glands and edge glands are similar in appearance and position to those of the male.

*Frontal organ and first antenna* (Fig. 7E). These are similar in proportions and armature to *C. reticulata*.

*Second antenna* (Figs 7B & D). The proportions of the protopodite, exopodites and longest swimming seta are equivalent to those in the *C. reticulata* female. On the basal article of the endopodite the *b* seta bears a few short bristles. The second endopodite article has a single fairly long spine as well as the usual two setae. No equivalent spine was seen in *C. reticulata*.

*Other appendages* (Figs 8A–G). These appear to be similar to *C. reticulata* females.

REMARKS. 74 specimens were identified from *Discovery* material all occurring in bathypelagic hauls at stations between 10°N and 31°N in the Atlantic. Besides the 34 females and 21 males there were 13 stage VI juveniles (2.8, 2.9, 3.0, 3.1, 3.1, 3.1, 3.1, 3.1, 3.1, 3.1, 3.2 and 3.2 mm) 4 stage V juveniles (2.1, 2.3, 2.4 and 2.4 mm) and two stage IV juveniles (1.3 and 1.5 mm). The limited data available suggests that the adults occur in depths between 2500 m and 3500 m, deeper than *C. reticulata* though the juveniles can be found at shallower levels.

The BM(NH) holds some material recorded as *C. reticulata*, registration number 1924.7.19.182–183, 'Gauss' station, Deutsche Südpolar-Expedition 1901–1903, S Atlantic (loc.) which was purchased from the Berlin Museum. The tube contains two adult *C. macroreticulata*, one male and one female, and a label stating 'Gaussexp' and the date '22.x.01'. Müller in his report of the Ostracoda of the Deutsche Südpolar Expedition (1909) gives details for the station worked on 22.x.01 as 23°33'S 16°59'W, fished to 3000 m over a sounding of 5045 m, but he does not record *C. reticulata* as occurring at this station, so there is an element of doubt that he was responsible for identification of this material. Furthermore the male measures 3.8 mm, much larger than the size of 3.1 mm given by Müller for the male of *C. reticulata* in both his original description (1906) and in his later *Das Tierreich* (1912).

### *Conchoecia spinireticulata* sp. nov.

*Conchoecia reticulata* Müller 1906 (*pro parte*). *Ergeb. Tiefsee-Exp.* **8**, p. 64 pl. 12 f. 10–17.

*Conchoecia reticulata* Müller 1912 (*pro parte*). *Das Tierreich—Ostracoda Berlin* p. 71.

*Macroconchoecia reticulata* (Müller) Granata & di Caporiacco 1949. *Rés. Campagnes Scientifiques* **109** p. 1–51.

*Conchoecia reticulata* Müller. G. B. Deevey 1968. Peabody Museum of Natural History, Yale University. *Bull.* **26** p. 38 fig. 13.

*Paraconchoecia reticulata* (Müller) E. M. Poulsen 1973. *Dana Report* **84**, p. 31–35 f 12a–l.

*Conchoecia* sp. aff. *reticulata* Müller. M. V. Angel, 1979. *Prog. Oceanog.* **8**, p. 57–58.

*Conchoecia reticulata* Müller. G. B. Deevey & A. L. Brooks 1980. *Bull. Florida State Mus.* **26** (2) p. 76–80 fig. 17.

*Conchoecia* sp. aff. *C. reticulata* Müller. M. V. Angel 1981. *Atlas del Zooplancton del Atlantico sudoccidental* ed. D. Boltovskoy, p. 559 f 194–78.

### Male

The holotype mounted on slides in Euparal and stained with lignin pink, has been deposited at the BM(NH) No. 1982: 178. It has a carapace length of 3.4 mm and was caught at *Discovery* station 7856 (30°13.6'N 23°01.9'W) haul 51 with the RMT 1.

*Carapace* (Figs 9A, C & H). The lengths of the 88 male specimens ranged between 2.8 mm and 3.4 mm averaging 3.2 mm. Carapace shape is similar to *C. reticulata*. The nature and position of the carapace glands are similar to *C. reticulata* though there are rather more edge glands along the posterior margin. The shoulder vaults are slightly enlarged and heavily armoured with spines. The spines are arranged in nearly horizontal rows in the anterior-

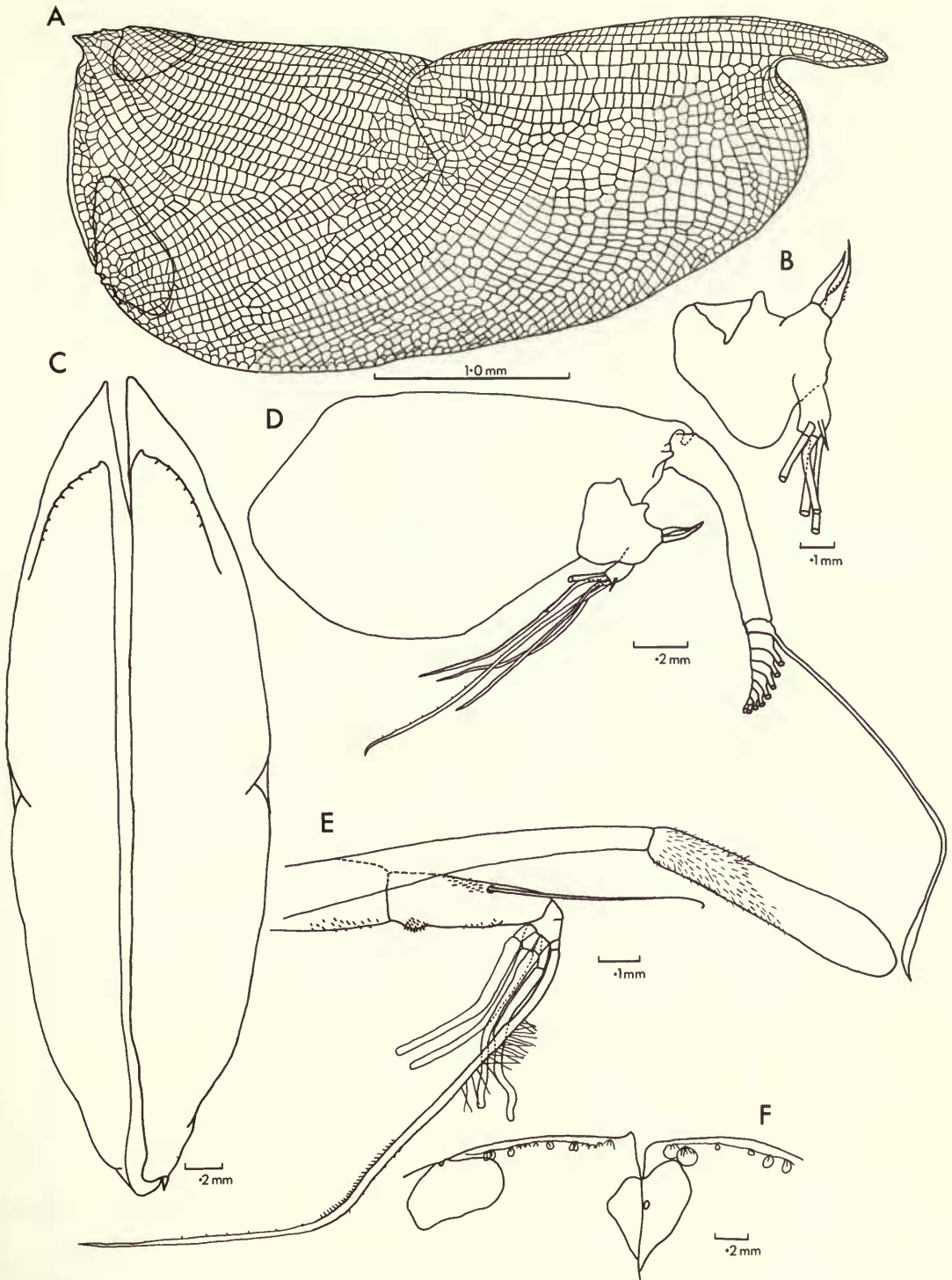


Fig. 7. *C. macroreticulata* ♀. A: Carapace, lateral view. B: Detail of endopodite of second antenna. C: Ventral view of carapace. D: Second antenna. E: Frontal organ and first antenna. F: Detail of the posterior carapace glands.

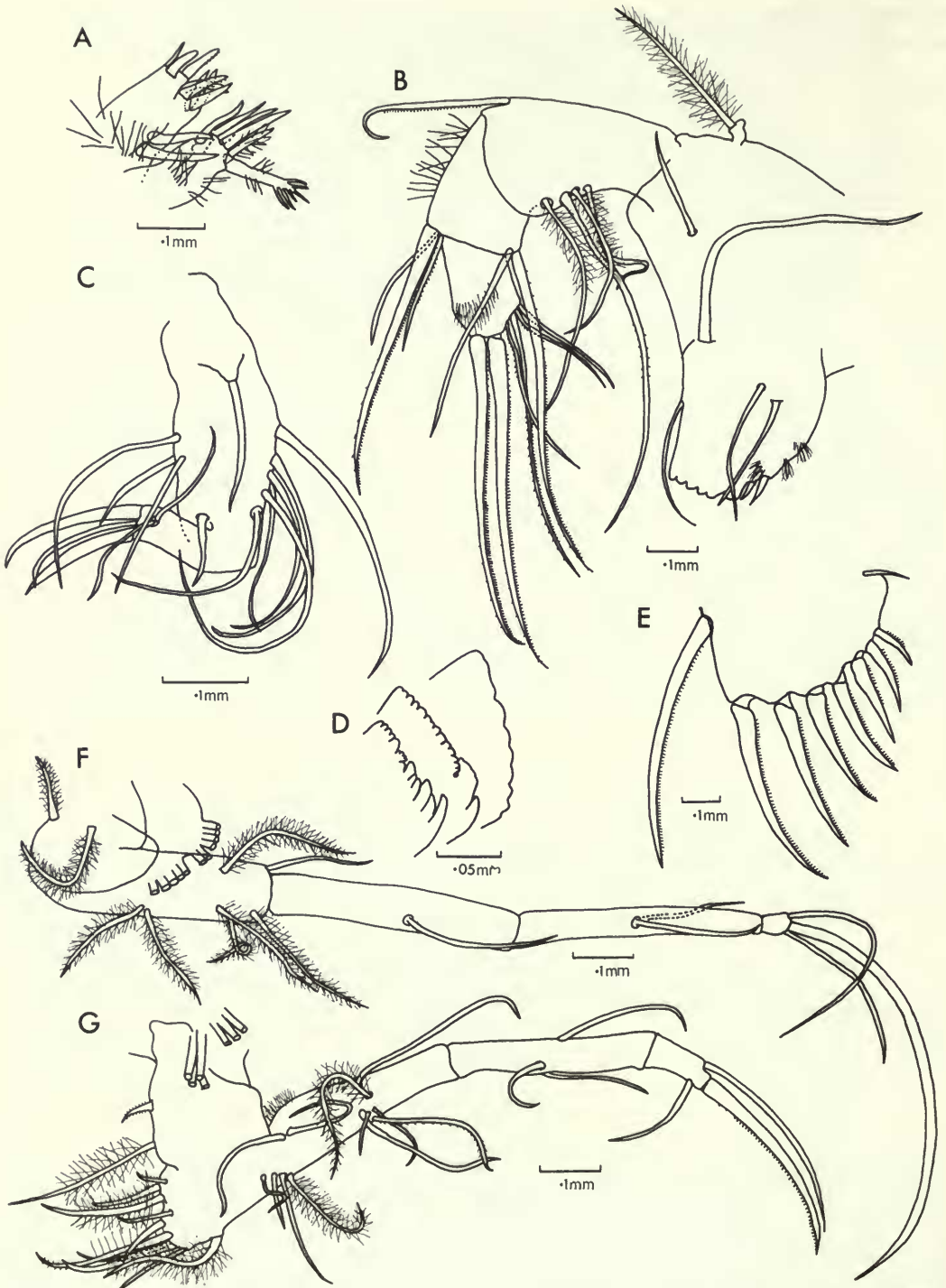


Fig. 8 *C. macroreticulata* ♀. A: Coxa of maxillula. B: Basale and endopodite of mandible. C: Endopodite of maxillula. D: Toothed edge of coxale and tooth lists of mandible. E: Caudal furca. F: Sixth limb. G: Fifth limb.

dorsal quarter. The ventral three rows have enlarged spines and curve into the notch behind the shoulder vaults. The more dorsal rows run across the top of the notch. In the posterior dorsal quarter there are parallel rows of narrow rectangles armoured with small spines along the near-horizontal lines. The posterior ventral quarter has similar sculpture with spines slanted diagonally downwards towards the back. In the anterior ventral quarter the sculpture is more squarrous and less well-marked. It is comparatively faint near the centre of the carapace and along the ventral and posterior margins.

*Frontal organ* (Fig. 9D). The proportions of the organ are similar to those of the previous species but the bristles on the capitulum are short.

*First antenna* (Figs 9D & E). The relative proportions of the setae differ from *C. reticulata* (Table 1). The *c* seta is a little shorter with the *b*, *d* and *e* setae longer. The armature of the *e* seta differs in having 83 pairs of spines rather than 50 pairs as in the previous species.

*Second antenna* (Figs 9B, F & G). As in *C. macroreticulata* the *f*, *g* and the longest swimming setae are relatively longer than in *C. reticulata*. The *b* seta on the endopodite lacks long bristles.

*Penis* (Fig. 10E). This differs from the previous species in having only four oblique muscle bands.

*Other appendages* (Fig. 10). These are similar to those of *C. reticulata*.

## Female

The paratype specimen, carapace length 3.8 mm, stained with lignin pink and mounted on slides in Euparal, has been deposited at the BM(NH) No. 1982: 177. It was caught at *Discovery* station 7856 (30°03.7'N 23°00.2'W) haul 50 with the RMT 1.

*Carapace* (Figs 11A, B & F). The 80 female specimens ranged in length between 3.2 and 3.9 mm averaging 3.7 mm. Like the previous species, the features of the carapace are much like those of the male but the rostrum tapers more gradually and is longer.

*Second antenna* (Figs 11D & E). The proportions of the protopodite exopodites and longest swimming seta are equivalent to the previous species. As in *C. macroreticulata* and unlike *C. reticulata* the *b* seta of the endopodite has a few short bristles and the second article bears a single long spine.

*Other appendages* (Fig. 12). These are similar to those of *C. reticulata* females.

REMARKS. 626 specimens were identified from *Discovery* material, all at mesopelagic or deep mesopelagic depths from stations between 0°–32°N in the Atlantic. Besides the 88 males and 80 females there were 117 stage VI juveniles ranging in size from 2.4–3.0 mm, 188 stage V juveniles, 1.6–2.2 mm and 153 stage IV juveniles 1.1–1.5 mm. All the juvenile instars bore rows of spines on the carapace. The data from all stations have been combined and plotted in Fig. 13 to show the generalised depth distributions of the instars and adults. Stage IV instars were commonest between 600 m and 800 m, stage V between 700 m and 900 m, stage VI between 1000 m and 1250 m, adults between 1000 m and 2000 m. Ontogenetic migration into deeper water with age is common in many halocyprid species (Angel, 1979).

## *Conchoecia caudata* Müller 1891

*Conchoecia caudata* G. W. Müller 1891. Zool. Jahrb. Syst. 5 p. 276 pl. 29 f 45–49.

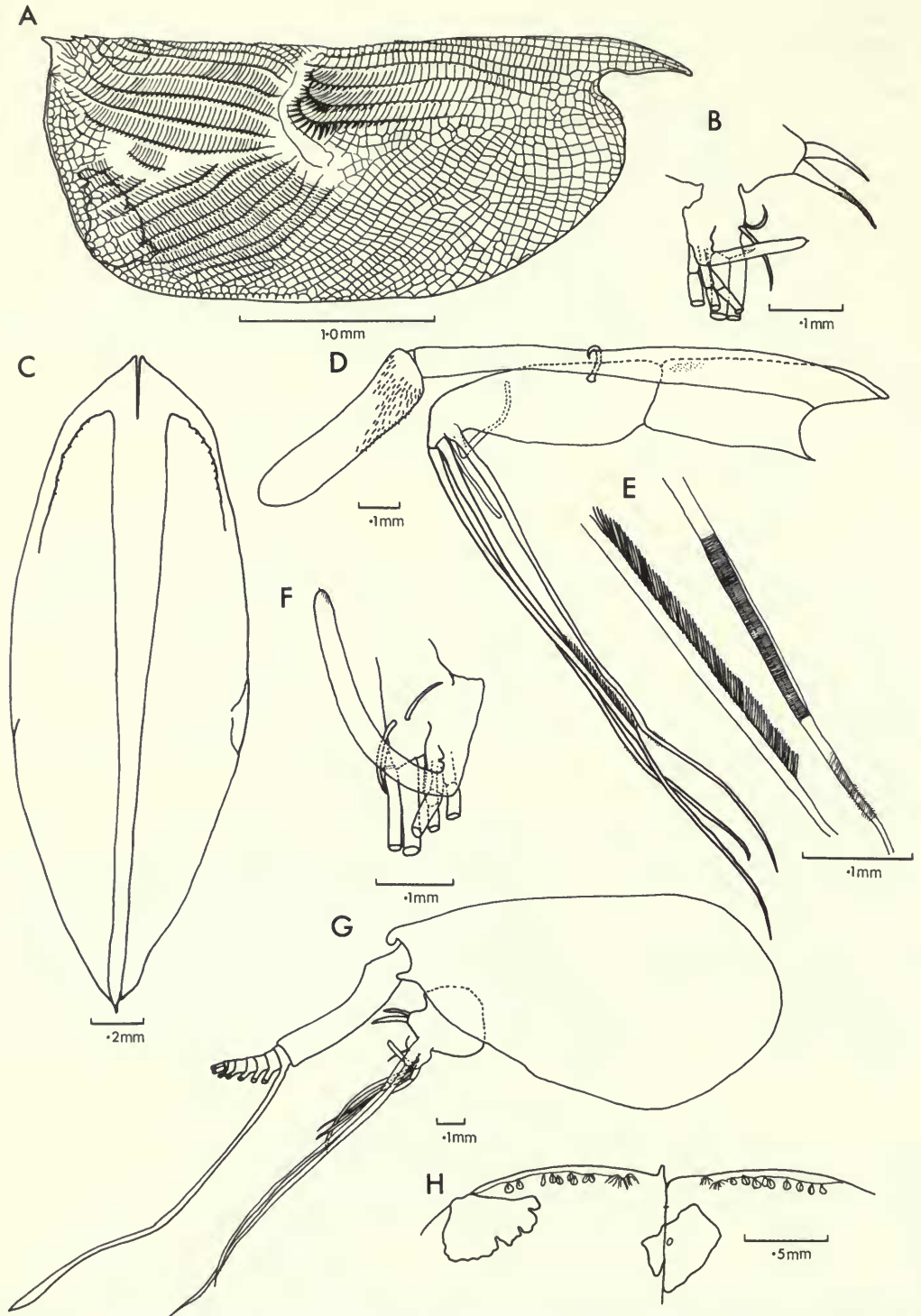
*Conchoecia caudata* G. W. Müller 1906. Ergeb. Tiefsee-Exp. 8 p. 65 pl 11 f 24, pl. 12 f 1–9.

*Conchoecia caudata* G. W. Müller 1912. Das Tierreich—Ostracoda Berlin p. 71.

*Paraconchoecia caudata* E. M. Poulsen 1973. Dana Report 84 p. 35–42 fig. 13a–o.

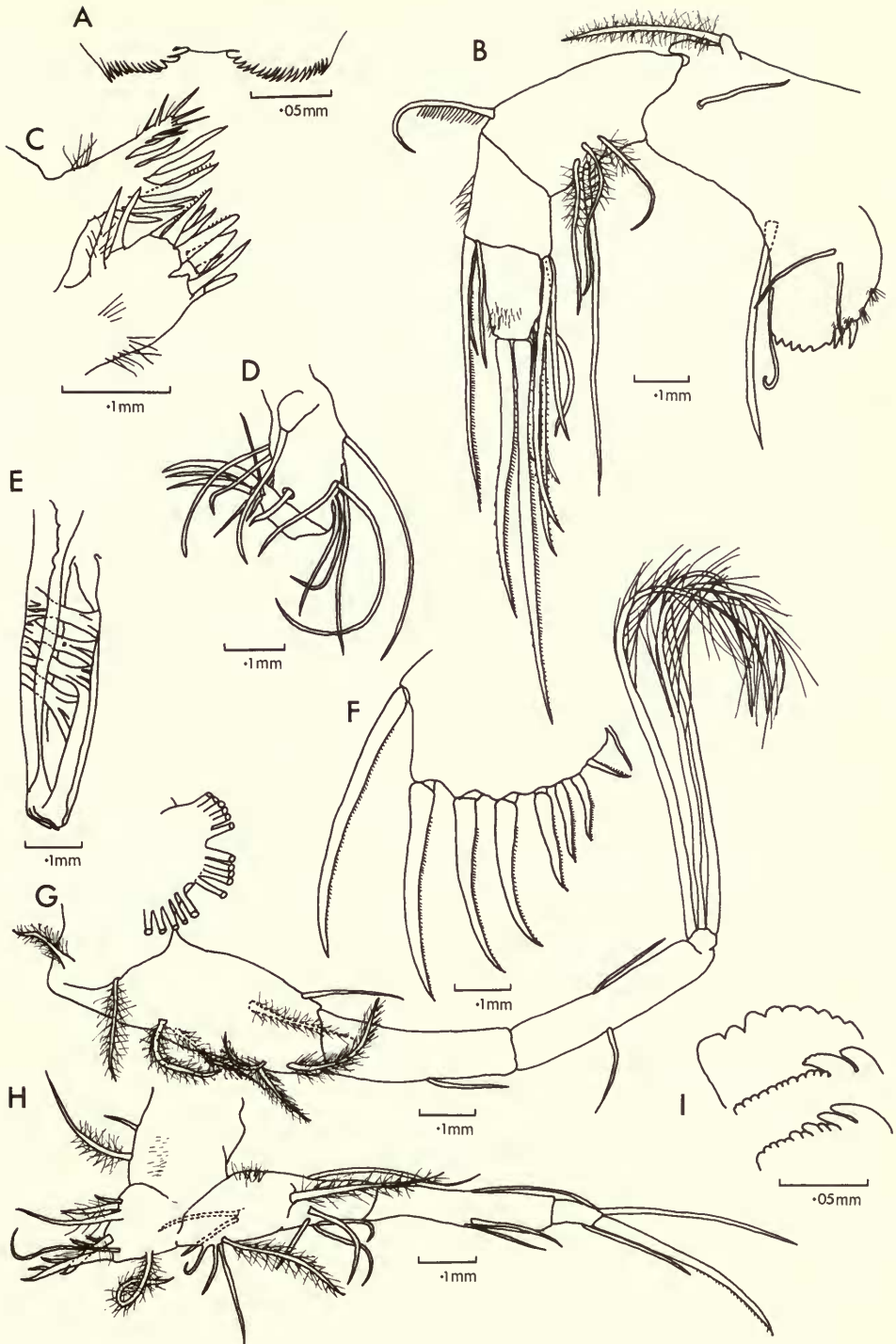
## Male

A male with a carapace length of 5.6 mm, measured from the tip of the left valve rostrum to the tip of the right valve posterior dorsal spine, stained with lignin pink and mounted on slides in Euparal has been deposited at the BM(NH) No. 1982: 192. It was caught in the Indian Ocean at *Discovery* station 5345 (16°58'S 67°31.1'E) with an Isaacs-Kidd Midwater Trawl (Foxton, 1969).

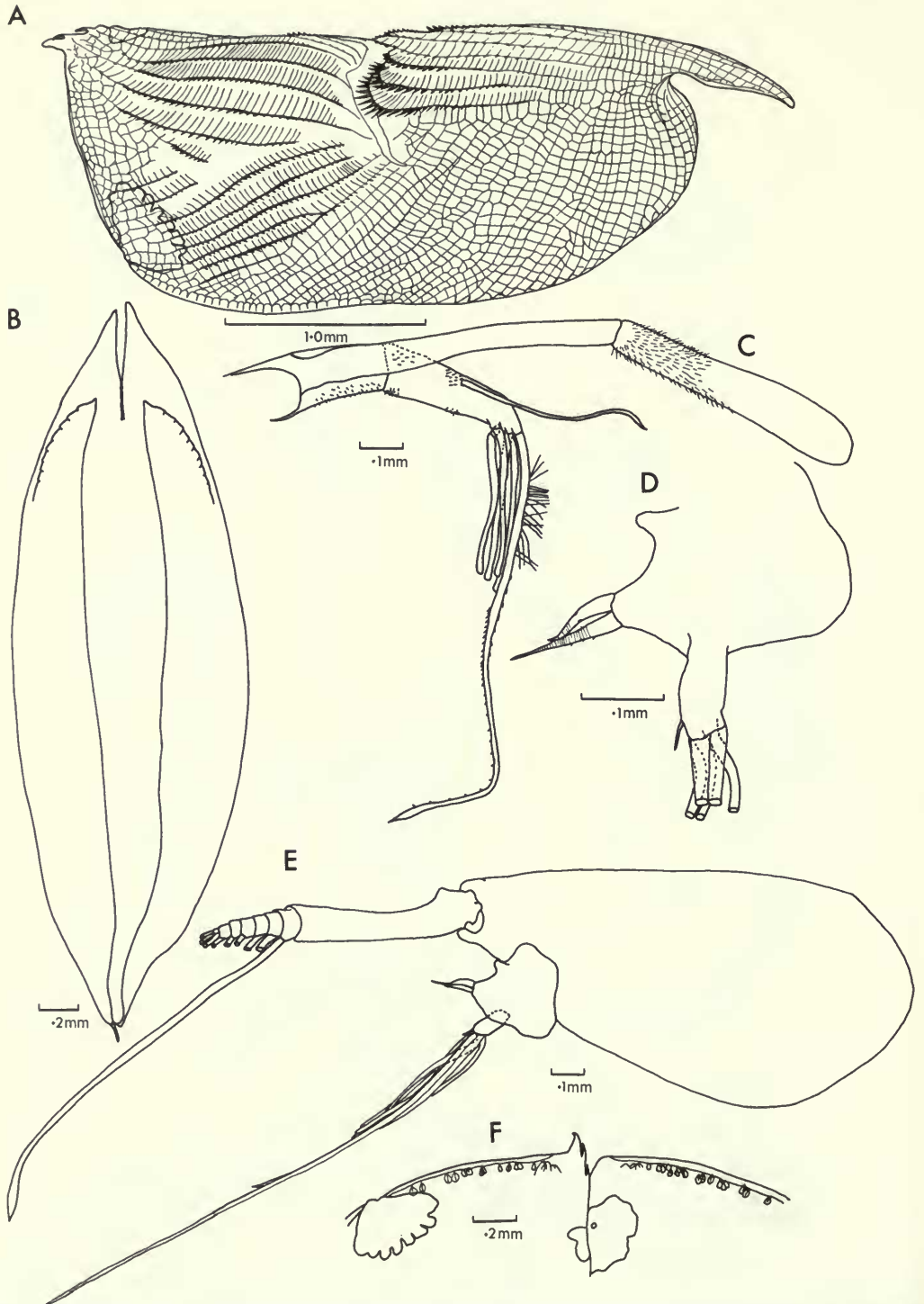


**Fig. 9** *C. spinireticulata* ♂. A: Carapace, lateral view. B: Detail of endopodite of left second antenna. C: Ventral view of carapace. D: Frontal organ and first antenna. E: Detail of *b* and *e* seta armatures. F: Detail of endopodite of right second antenna. G: Second antenna. H: Detail of the posterior carapace glands.

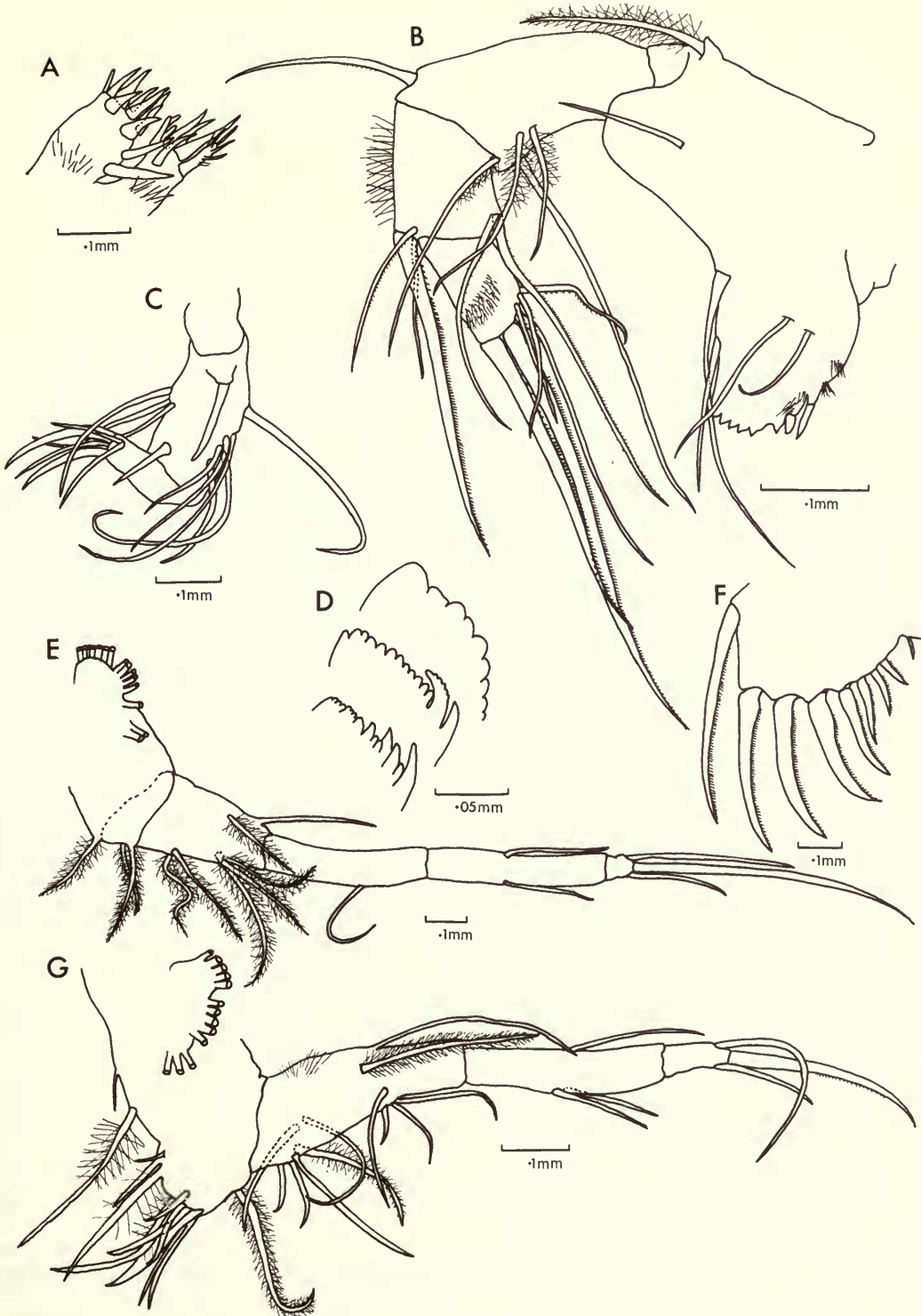




**Fig. 10** *C. spinireticulata* ♂. A: Toothed edge of labrum. B: Basale and endopodite of mandible. C: Coxa of maxillula. D: Endopodite of maxillula. E: Penis. F: Caudal furca. G: Sixth limb. H: Fifth limb. I: Toothed edge of coxale and tooth lists of mandible.



**Fig. 11** *C. spinireticulata* ♀. A: Carapace, lateral view. B: Ventral view of carapace. C: Frontal organ and first antenna. D: Detail of endopodite of second antenna. E: Second antenna. F: Detail of the posterior carapace glands.



**Fig. 12** *C. spinireticulata* ♀. A: Coxa of maxillula. B: Basale and endopodite of mandible. C: Endopodite of maxillula. D: Toothed edge of coxale and tooth lists of mandible. E: Sixth limb. F: Caudal furca. G: Fifth limb.

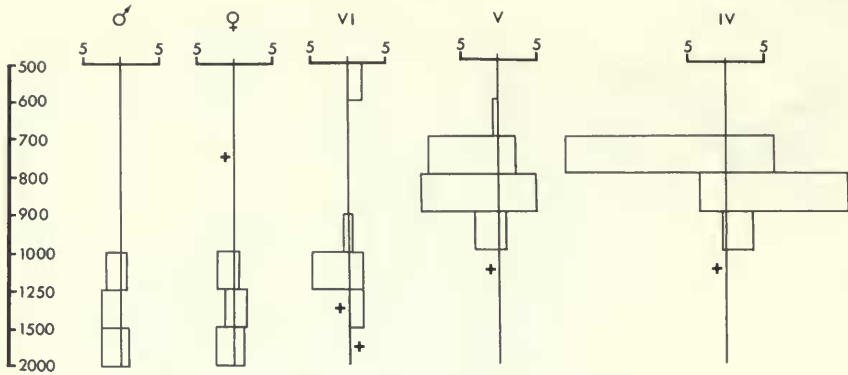


Fig. 13 Vertical profiles of density of *C. spinireticulata* (numbers per 2 hour tow) of males, females and juveniles (stages VI, V & IV) by day (on left) and by night (on right). Data combined from all stations. + indicates presence in densities of less than 0.5 per 2 hr tow.

*Carapace* (Figs 14A, C & H). The size of the five males, averaging 5.61 mm, none significantly damaged, were 4.8 mm, 5.6 mm, 5.6 mm, 6.0 mm and 6.1 mm, an unusually wide range which may prove indicative of two size forms. The posterior dorsal corner of the left valve is drawn out into a short spine, whilst that of the right valve is produced into a long laterally-flattened spine which bears dorsal and ventral secondary spines. Near the base of the primary spine the ventral secondary spines are much smaller than the opposite dorsal ones but distally they are of more equal size. The left asymmetrical gland opens on a bump just anterior to the hinge. The posterior margin is curved and slopes anteriorly. Midway, on both valves, are prominent glands which open on the exhalent siphon and may be bioluminescent glands. These are flanked by a number of edge glands. The right asymmetrical gland opens just dorsal to the strongly curved posterior ventral corner. The rostrum is particularly elongate and tapers narrowly, that of the left valve is longer than the right. Glandular cells are present both in the rostrum and the long spine, these could be bioluminescent.

The sculpture resembles that of *C. spinireticulata*. In the posterior quarter there are five parallel rows of spines, the most ventral of which is short. These slope slightly upwards towards the back, but do not meet the dorsal hinge. Faint narrowly-spaced lines run at right-angles to these lines. In the posterior ventral quarter there are two short parallel rows of spines which slope downwards towards the back. Over the slightly expanded shoulder vaults the sculpture runs parallel to the dorsal hinge. The four bottom lines are armoured with spines. The top row of spines is straight but the bottom three rows curve over the posterior part of the shoulder vaults, at which point the spines are particularly long, and end in the notch. In the anterior ventral quarter the sculpture consists of faint squares or polygons, with the ventral corners drawn out into spines which get longer closer to the ventral margin. Along the ventral margin the spines are quite long and extend beyond the edge.

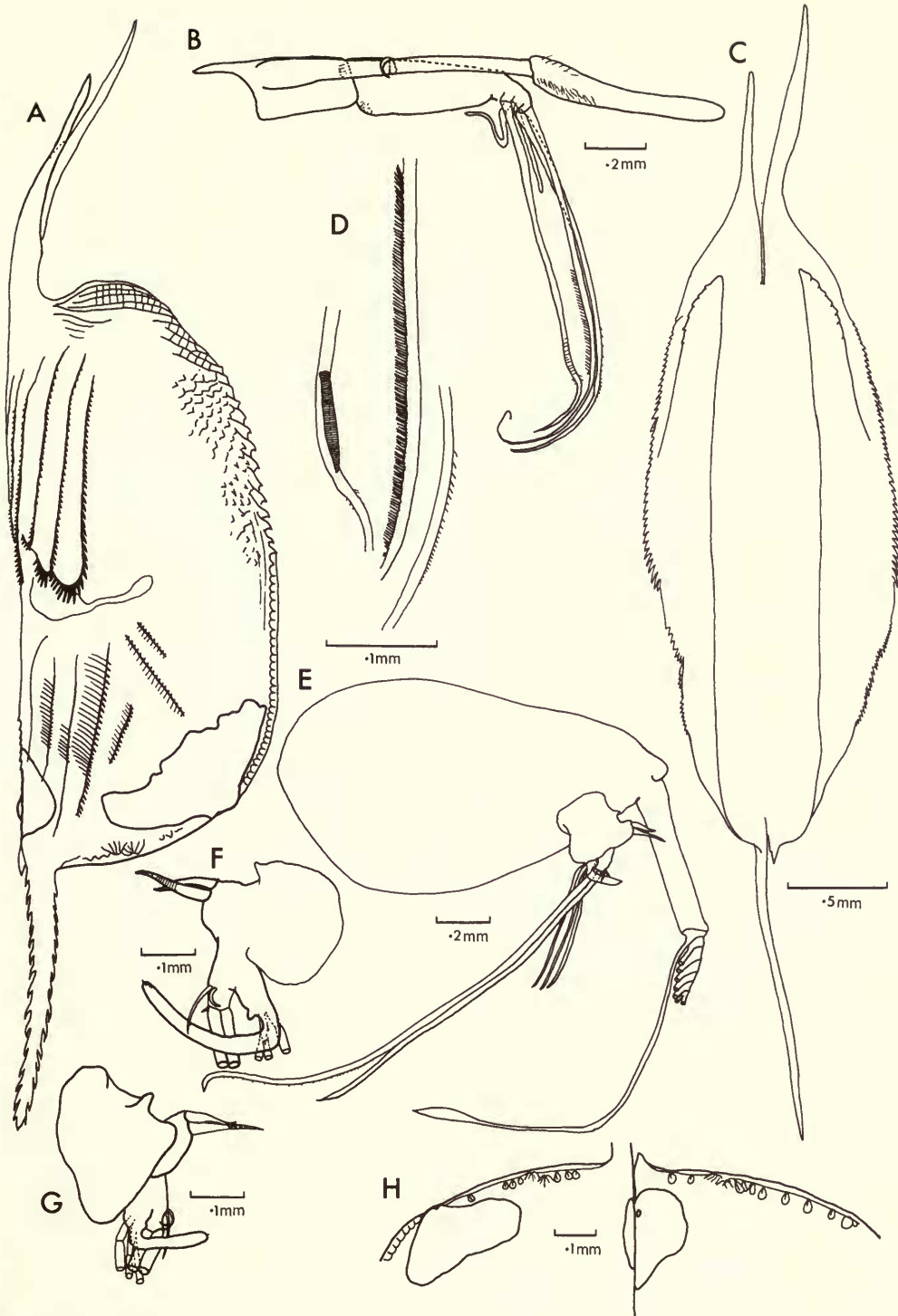
*Frontal organ* (Fig. 14B). The shaft reaches level with the end of the second segment of the first antenna. The capitulum, slightly narrowed in the distal half, has lateral bands of hairs with a few scattered dorsally and ventrally.

*First antenna* (Figs 14B & D). The main differences in the details of this appendage compared to *C. spinireticulata* are that there are about 95 pairs of spines on the *e* seta, and the callus on the *b* seta is relatively short and compact.

*Other appendages* (Figs 15A–I). These are all similar to those of *C. spinireticulata* with the exceptions of the single outer-face seta of the first segment of the mandibular endopodite, which has a row of short bristles, and the five oblique muscle bands of the penis.

## Female

A female specimen, carapace length 6.7 mm, stained with lignin pink and mounted on slides



**Fig. 14** *C. caudata* ♂. A: Carapace, lateral view. B: Frontal organ and first antenna. C: Ventral view of carapace. D: detail of the *b*, *d* and *e* setae armatures. E: Second antenna. F: Detail of endopodite of right second antenna. G: Detail of endopodite of left second antenna. H: Detail of posterior carapace glands.

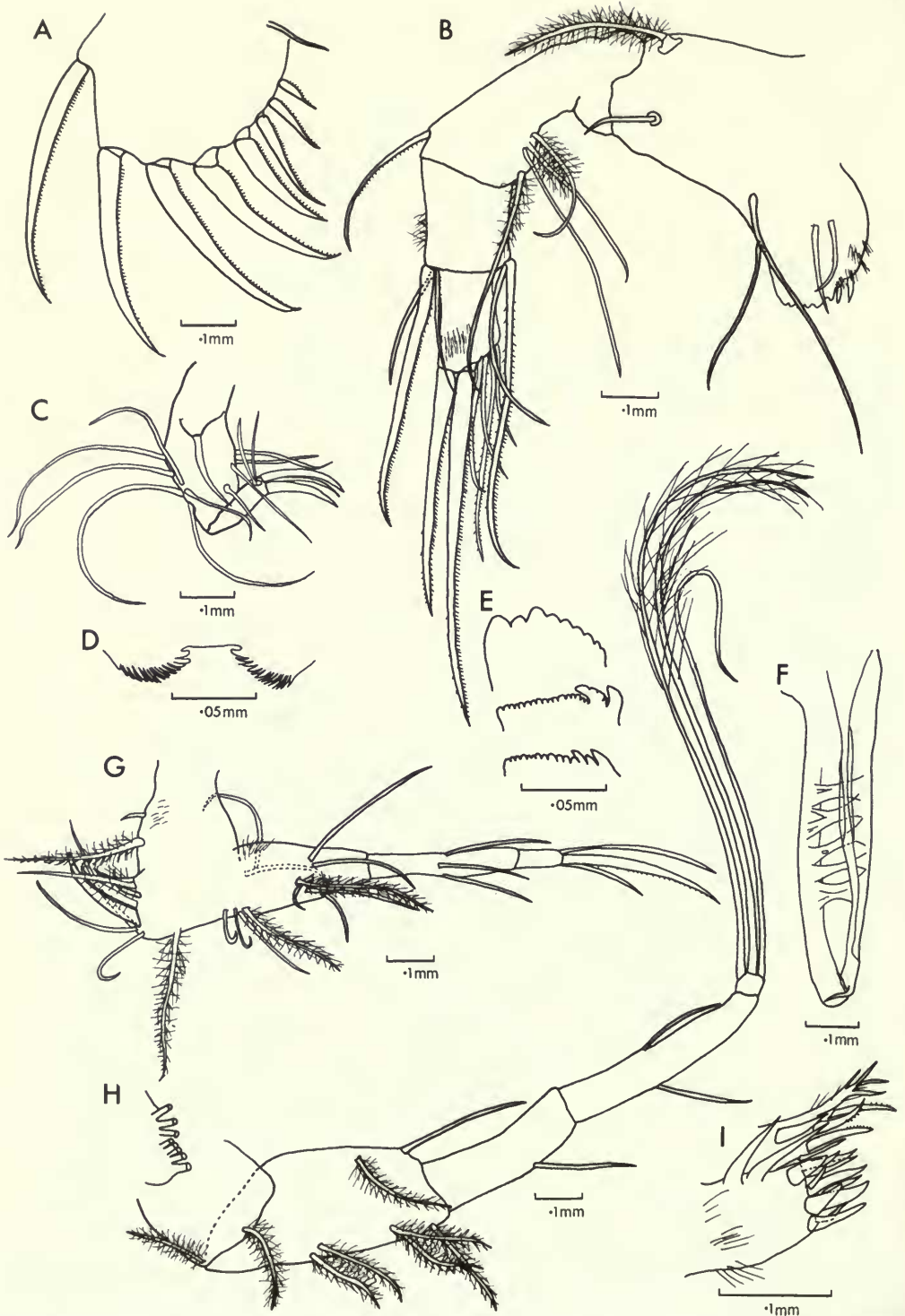


Fig. 15 *C. caudata* ♂. A: Caudal furca. B: Basale and endopodite of mandible. C: Endopodite of maxillula. D: Toothed edge of labrum. E: Toothed edge of coxale and tooth lists of mandible. F: Penis. G: Fifth limb. H: Sixth limb. I: Coxa of maxillula.

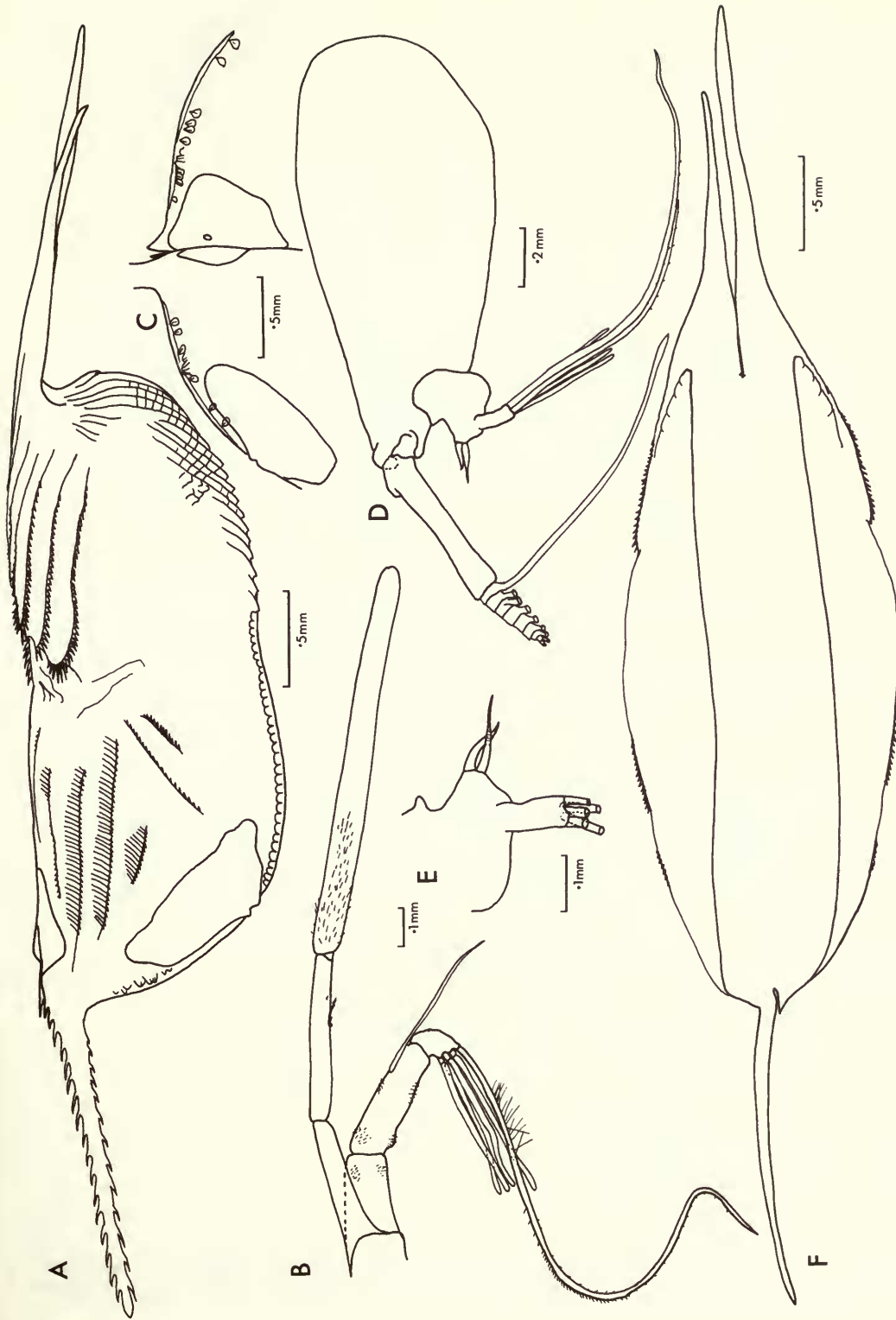
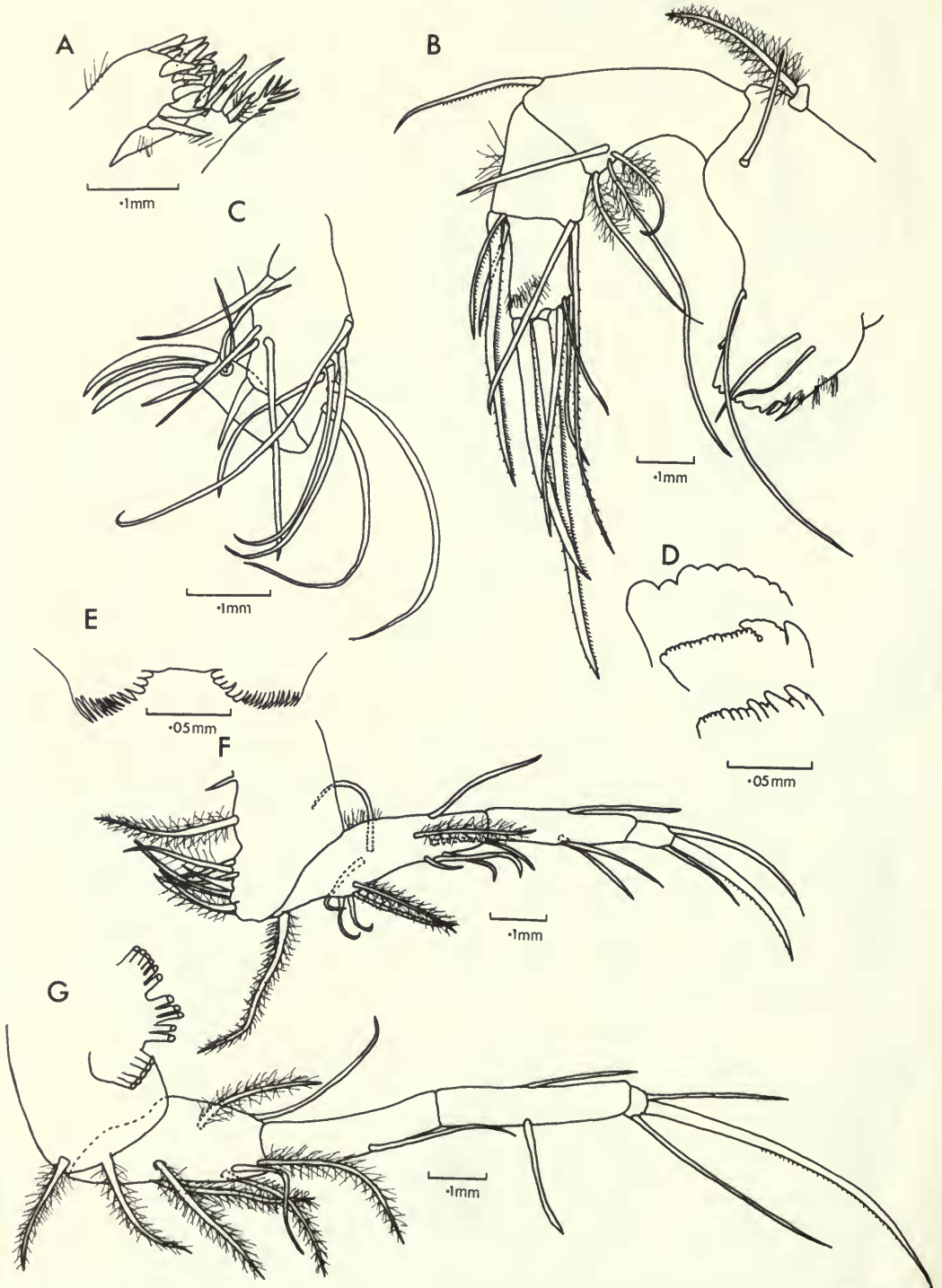


Fig. 16 *C. caudata* ♀. A: Carapace, lateral view. B: Frontal organ and first antenna. C: Detail of posterior carapace glands. D: Second antenna. E: Detail of endopodite of second antenna. F: Ventral view of carapace.



**Fig. 17** *C. caudata* ♀. A: Coxa of maxillula. B: Basale and endopodite of mandible. C: Endopodite of maxillula. D: Toothed edge of coxale and tooth lists of mandible. E: Toothed edge of labrum. F: Fifth limb. G: Sixth limb.



in Euparal has been deposited at the BM(NH) No. 1982: 191. It was caught in the same haul as the male.

*Carapace* (Figs 16A, C & F). Of the eight females caught, one had a badly damaged posterior dorsal corner spine. The other seven ranged in size from 6.7 mm to 7.6 mm averaging 7.18 mm. The details of the shape sculpture and glands are similar to those of the male.

*Frontal organ* (Fig. 16B). The capitulum is narrow and exceptionally elongate with short spines on the proximal half.

*Second antenna* (Figs 16D & E). Unlike *C. spinireticulata* the second article of the endopodite lacks a spine.

*Other appendages* (Fig. 17). These appear to be similar in all respects to *C. spinireticulata* females.

REMARKS. 17 specimens of *C. caudata* were identified from *Discovery* material from the Indian Ocean. Besides the five males and eight females there were three stage VI juveniles (6.4 mm, 6.0 mm, 5.6 mm) and one stage V juvenile (4.9 mm). There was too little material available to comment on the depth distribution of the species.

It appears to be an Indo-Pacific species, absent from the Atlantic. Although Müller (1906) recorded it from two Atlantic stations, 55 Vb, near 2°N 3°E and 91V near 33°S 16°E. This may be a mistake as it has not been found in *Discovery* Atlantic material (Angel, pers. comm.), Poulsen did not record it in either his *Dana* Report (1973) or his paper on the Ostracoda of the eastern tropical Atlantic (1969), nor Deevey in collections from the Sargasso Sea (1968, 1980), Caribbean (1970) and SW Atlantic (1974).

### Discussion

In 1906 Müller placed *C. caudata* and *C. reticulata* in his *Spinifera* group of *Conchoecia* species which he characterised by the spine at the posterior dorsal corner of the right valve, long thin hairs proximally on the anterior surface of the female principal seta, the posterior margin of the mid part of the male principal seta equipped with long proximally-pointing, bristle-like close-set spines and distal to these a group of distally-directed spines, distinctive *b* and *d* setae armature and no lateral glands. This group included *C. spinifera*, *C. oblonga*, *C. allotherium*, *C. aequiseta*, *C. hirsuta*, *C. inermis*, *C. dasyophthalma*, *C. dorsotuberculata*, *C. echinata* and *C. mamillata* as well as *C. caudata* and *C. reticulata*. The grouping of these species has been criticised by both Skogsberg (1920) and Poulsen (1973) who pointed out the inconsistencies resulting from juxtaposing these undoubtedly heterogeneous species.

Nevertheless, *C. caudata*, *C. reticulata*, *C. macroreticulata* and *C. spinireticulata* all exhibit the characters outlined by Müller for the *Spinifera* group, with the exception that *C. caudata* is the only one of the four species with distally directed spines on the male principal seta. The four species themselves are clearly closely related having in common the comparatively few small edge glands along the posterior margin, paired glands in both sexes, bristles on the frontal organ in the male, cylindrical frontal organ in the female, short bristles on the posterior margin of the mid-section of the female principal seta and a wing-like callus on the *b* seta of the male first antenna alongside short bristles on the *d* seta.

The carapace, frontal organ and first antenna of the other species of Müller's *Spinifera* group were examined to see if any shared these additional *Reticulata* group characters. It was found that though none of the other species fitted into this category, *C. spinifera*, *C. oblonga* and *C. allotherium* form an equivalently close-knit group. They have in common many edge glands, paired glands in the males only, no bristles on the male frontal organ, a distinctively shaped and sharp pointed tip to the female frontal organ, long stiff bristles on the posterior margin mid-section of the female principal seta, approximately 30 pairs of proximally-pointing spines of the male principal seta are large robust and wider-spaced, distal to them is a single distally directed leaf-like spine, the *d* seta lacks armature and the *b* seta lacks a wing-like callus. Of the other species, *C. aequiseta* and *C. hirsuta*, which differs from *C. aequiseta* in only minor details of the appendages and distribution (Angel, pers.

comm.), *C. echinata*, *C. dorsotuberculata* and *C. inermis* have various combinations of characters which indicate affinity with the *Reticulata* and *Oblonga* groups, whilst each species has unique features. These species serve to underline the problems inherent in attempting to split up the massive genus *Conchoecia* into subgenera or genera. The three other *Spinifera* group species *C. dasyophthalma*, *C. mamillata* and *C. nanomamillata* share few common characteristics with any of the other species and there seems little basis for suggesting any particular affinity.

Within the *Reticulata* group the carapace details point to greater affinity of *C. macroreticulata* with *C. reticulata* and *C. caudata* with *C. spinireticulata* similarities which are emphasised by the few appendage distinctions. Thus *C. spinireticulata* and *C. caudata* have no hairs on the *b* seta of the male second antenna endopodite, which *C. reticulata* and *C. macroreticulata* have, the hairs on the male frontal organ are not so long as in *C. macroreticulata* and *C. reticulata* and the numbers of pairs of spines on the male principal seta are broadly equivalent in these pairs of species.

### Key to the species of the *Reticulata* group

1. (i) Carapace sculpture armoured with rows of spines which are especially pronounced on the shoulder vaults and in the posterior dorsal region. In the  $\sigma$  there are no hairs on the *b* seta of the second antenna and there are between 80–100 pairs of bristles on the principle seta ..... 2
- (ii) Carapace not armoured with such spines though in one species there are some small spines along the ventral margin. In the  $\sigma$  the *b* seta of the second antenna bears hairs, the frontal organ has relatively long hairs and there are about 50 pairs of bristles on the principal seta ..... 3
2. (i) The posterior dorsal corner (PDC) of both valves are drawn out into spines, that of the left valve is fairly short and that of the right valve is exceptionally long and it is about 25% of the total carapace length. The rostrum is similarly elongate and is slightly longer on the left valve than on the right. The paired glands are situated about half way down the posterior margin.  $\varphi$  6.75–7.6 mm  $\sigma$  4.82–6.12 mm (lengths inclusive of spine and rostrum) ..... *C. caudata*
- (ii) The PDC of the right valve is drawn out into a spine whereas that of the left valve is rounded. Neither the spine nor the rostrum are particularly extended. The paired glands are situated just ventral to the PDC.  $\varphi$  3.2–3.9 mm  $\sigma$  2.8–3.4 mm ..... *C. spinireticulata*
3. (i) Carapace with small spines projecting from the ventral margin especially on the left valve. The ventral margin, in the central section is nearly parallel to the dorsal hinge. In the posterior dorsal region the rows of sculpture are nearly horizontal  $\varphi$  3.2–3.4 mm  $\sigma$  2.8–3.1 mm ..... *C. reticulata*
- (ii) Carapace tapers anteriorly and the ventral edge of the carapace lacks spines. The rows of sculpture, in the posterior dorsal region, slant dorsally.  $\varphi$  3.8–4.4 mm  $\sigma$  3.4–4.0 mm ..... *C. macroreticulata*

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